DOCUMENT RESUME

ED 272 286 PS 015 917

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TITLE Relationships between Logical Thinking and Knowledge of Basic Language Concepts with Children at the Preoperational Stage of Development.
PUB DATE [85]
NOTE 23p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Age Differences; *Cognitive Development; Kindergarten; Kindergarten Children; *Language Acquisition; *Preschool Children; Preschool Education
IDENTIFIERS *Piagetian Tasks

ABSTRACT

The present study investigates the acquisition of basic language concepts with children 4 and 5 years of age, and the relationship of language to cognitive development as measured by performance on 10 Piagetian tasks. Factors of age, day care setting or kindergarten, and sex constituted the independent variables. Children 4 years of age proved to be significantly less competent on language concepts than 5-year-olds. Such incompetence correlated positively with their poor performance on the operational tasks. Five-year-olds, whether in day care or kindergarten, did not differ on language ability. Among 5-year-olds a trend was found toward negative correlations between high performance on language concepts and lack of achievement on operational tasks of logical thinking. These findings are largely consonant with much of the research and indicate that while 5-year-old children have an almost adult understanding of language, they do not have much success in performing operational tasks. Some inability to decenter and consider all relevant variables may be responsible for such failures, or 5-year-olds' reliance on perceptual features of the task may account for low performance on cognitive tasks. (Author/RH)

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ED272286

RELATIONSHIPS BETWEEN LOGICAL THINKING AND KNOWLEDGE OF BASIC LANGUAGE CONCEPTS WITH CHILDREN AT THE PREOPERATIONAL STAGE OF DEVELOPMENT

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ABSTRACT

The child's development of language does not directly parallel attainment of operational logical thinking. Theorists have proposed different analyses of the relationships between these two competencies in young children. The present study investigates the acquisition of basic language concepts with children four and five years of age, and the relationship of language to cognitive development as measured by performance on ten Piagetian tasks. Factors of age, day care setting or Kindergarten, and sex constituted the independent variables. Four year olds proved to be significantly less competent on language concepts and this correlated positively with their poor performance on the operational tasks. Five-year-olds whether in day care or Kindergarten did not differ on language ability. With the five-year-olds there was a trend toward negative correlations between high performance on language concepts and lack of achievement on operational tasks of logical thinking. These findings are largely consonant with much of the research and indicate that while a child of five has an almost adult understanding of language, there is a lack of successful performance on operational tasks. Some inability to decenter and consider all relevant variables may be responsible, or their reliance on perceptual features of the task may account for low performance on cognitive tasks.

RELATIONSHIPS BETWEEN LOGICAL THINKING AND KNOWLEDGE OF BASIC LANGUAGE CONCEPTS WITH CHILDREN AT THE PREOPERATIONAL STAGE OF DEVELOPMENT

Early language development and its relationship to operational thinking has been the focus of the research interests of cognitive psychologists, Sinclair-de-Zwart (1973), Chipman (1985), as well as linguists, Chomsky (1957, 1965), and psycholinguists, Bloom (1970), Slobin (1971), and Beilin (1975). The evolution of child speech from single holophrases to almost complete competence in spoken language by five years of age has not been found to directly parallel the child's achievement in logico-mathematical thinking. The question then becomes one of the relationship between language and cognitive systems as they are manifested in the developing child. Three major theoretical positions that have emerged from the research include: a) cognition or early operative intelligence precedes and informs language as one instance of the semiotic function, (Piaget, 1957, Inhelder, 1971, and Furth,1969); b) the theoretical position that language is an innate creative capacity that at times intersects with cognition but is separate from it, (Chomsky, 1957, Miller, 1962, and Lakoff, 1971); c) both cognition and language are systems that are informed at a deeper level by an abstract logic as proposed by Beilin, 1975.

The investigations of the development of language in relationship to operational intelligence have involved a broad range of children with ages ranging from infancy through young adulthood. The current study focuses on children at ages 4.0 to 5.11 years, which would encompass a stage of development characterized by cognitive psychologists as a medial one between early sensorimotor development and the concrete operational stage, that is, a stage commonly referred to as preoperational. Children at this stage should exhibit a transitory stage between strong reliance on sensory data

and perception and an intuitive pre-knowledge of objective logical concrete thinking. It was hypothesized by the present investigators that this phase of development between stages might reveal the flexibility and ambivalence of the evolutionary process for both language concepts and for logical thinking. There would also be in evidence examples of some reliance on perceptual aspects of thinking together with some tentative intuition in the child's capacity for decentration. In language, increasing familiarity with basic concepts as related to space, quantity, and time relationships should be in the process of emerging both in the surface structure of language and in the early stages of operational thinking. The research reported by Beilin and Spontak (1969) has proposed that the age period between 5 and 7 appears to be a time in which a critical change in language appears. By selecting children of ages 4 and 5, the current study looks at children who are on the threshold of this critical stage.

Another unique characteristic of the study is the comparison of the effect of day care training as it might influence the variables under study. Since an increasing number of young children, particularly in the large urban centers, are being exposed to the day care experience sometimes from infancy until four or five years of age, this variable was considered. Children who had been enrolled in day care centers for one or more years were contrasted with those who at approximately five years of age have their first formal group experience with the regular Kindergarten classroom. Interaction with other children in a formal setting was included for the effect it might have on language competence and/or the level of operational thinking. All of the children involved were from one urban setting and from approximately the same socio-economic level.

Recent Related Research

That operational intelligence precedes and informs language is the position consistently maintained by the Genevan school. With the earliest recognition that objects not in sight continue to exist, the infant manifests his/her knowledge that the object has permanence, not through language but through motoric action in seeking the absent object. Also the child's ability for deferred imitation at a very early age (about 16 months to 2 years) is another indication of the symbolic representation of an event. With the subsequent later use of holophrases and two and three-word sequences, the child's knowledge schemes continue to surpass the child's ability to express that knowledge in language. Piaget (1962) has maintained that verbal representation amounts to only one further kind of representation and that conceptual and symbolic representation which has preceded makes language possible. Furth (1969) reiterates this Piagetian concept by emphasizing that all symbolic functions, including language, are inherently dependent on the knowing activity of the child.

The question then becomes one of looking at the apparent discrepancy betweep the almost adult natural language of the child at a time (at 5 years of age) when his operational level of thinking is still at a comparatively primitive level. The research of Sinclair (1973) and Bloom (1970) on the child's acquisition of linguistic structures have proposed that the natural language of the five-year-old can be explained by positing pseudo-structures or prestructures which manifest themselves in spite of the fact that they often surpass the underlying cognitive capacity of the child. These studies suggest that such natural language may possibly have been assimilated by the child through modeling or imitation and tend to function in a type of holding position much as algorothmic subroutine functions.

The recent research of Chipman (1985) reports that although fluency in natural language is achieved by approximately five years of age, understanding of the internal grammar that governs language production is not attained until ten years of age. In an endeavor to analyze the parallel development between cognitive structures and the acquisition of language, Sinclair and Ferreiro (1970) carried out a series of studies on the relationship between active and passive sentences with children between 4 and 8 years of age. Their overall conclusions were that comprehension and production of the passive is related to reversibility, and further, that there is a developmental sequence in the production of the passive. Studies which paired young children's (4 to 8 years) logical reversibility with judgments on synonymity of active and passive sentences led Beilin and his fellow researchers (1975) to the conclusion that at the deep level linguistic structures are associated with cognitive processes which operate independently of the linguistic system. Other studies have investigated the child's understanding of the concepts of time, quantity, relationships as paralleled with language competence, (Bloom, 1970, Katz, 1972, and Weil, 1970). The present study by including many of the same variables endeavors to provide further perspectives on the relationship between cognition and language with young children.

The nativist position of linguistic development first proposed by Chomsky in 1957 held that language is an innate "creative" capacity of the child. He strongly rejected the behaviorist position that language acquisition rested on external stimulation acquired through imitation, reinforcement, and generalization. His transformational generative theory which posited an inherent language acquisition device (LAD) was later refined (1965) to include the distinction between competence and performance.

McNeill (1970), in the Chomskyan tradition, has proposed that with this given Language acquisition device (LAD) the child abstracts syntactic rules from a limited language base following the rules of an unexplained grammar. Ultimately, concepts such as surface structure, what the child articulates, and deep structure, comprehension or meaning have become of critical importance to linguists and psycholinguists in looking for the ultimate determinants of language. Efforts to examine the process by which the deep structure of meaning informs the surface structure has involved both tranformational generative scholars as well as those interested in information processing. Researchers Trabasso, Rollins, and Shauhnessy (1971) consider language as a process from initial input (stimulus) to the actual verbal response, and emphasize that language is a coherent system separate from logical thinking, but intersecting with cognition for the mutual benefit of both systems.

The thesis that logical structure functions as the principal common demoninator between language and cognitive development in defining the fundamental principals of both has been proposed by Beilin and his associates. This common logical form (yet unspecified as to its exact nature) determines the form of both cognitive and linguistic development. The cumulative results of the comparatively substantial body of research reported in his work, Studies in the Cognitive Basis of Language Development which involved children between the ages of 2 and 7, largely supports this position. However, there does appear to be some shift or at least some ambivalence in the concluding chapter which summarizes the results of these numerous studies. Beilin concludes that in spite of the fact that the linguistic system does have unique properties, the development of knowledge of this system is bound to be constrained by the properties of the child's cognitive logico-mathematical thinking and other structures.

In designing this study of the relationship of language to operational intelligence with four and five year old children, it is recognized that other factors such as the emotional, social, and environmental contexts have not been considered.

Hypotheses tested by the study

In an effort to contribute to the growing body of research which looks at the relationship between the young child's language and cognitive development, this study considers these variables with the child at the pre-operational level in both day care and non day care settings. The first hypothesis holds that children who have had an average of two years in a day care setting will not differ significantly from those for whom Kindergarten is the first formal school experience on knowledge of basis language concepts. It is further proposed that no differences will be found for age or sex. Knowledge of basic language concepts measured on a pre and posttest basis are used to provide information on the effect of the day care experience and on maturation over the three month period of the study.

Using the pretest scores on knowledge of basic language concepts, a stratified random sampling of 18 four and five year olds who scored high, medium, and low were selected and administered a series of ten Piagetian tasks as indicators of the level of their operational thinking. Comparisons were made between the children's performance on these tasks and their scores on the language tests. In addition to the total score comparisons, several sub-components of both measures on the concepts of space, quantity, and classification/seriation were further analyzed. Since items on both the basic language concepts tests, pre and post, and the selected Piagetian tasks included these three categories, comparisons of the child's cognitive information about these concepts were evaluated with reference to the child's linguistic information on the same concepts. Only children of four or five

year old groups in the day care setting participated in the Piagetian tasks. Thus, hypotheses that levels of performance on tests of basic language concepts would be unrelated to performance on cognitive operational tasks, and that this lack of relationship would persist for the concepts of space, quantity, and seriation/classification were posited.

Method

Fifty-two four and five year olds, from two inner city day care centers and two parochial school Kindergartens were included in the study. The children in the day care centers had a mean number of years attendance of two years, with a range years of attendance between 1.6 to 3.6 years. Children selected from the two Kindergartens met the criteria that they had not attended any day care center prior to Kindergarten. About 98% of the children were from black families. Although 90% of the children in the day care setting were reported as coming from single parent families, this information may have been influenced in actuality by the fact that admission to the day care center was based on minimal family income and only one parent's income could have been reported. The study included four groups of 13 children, and the children from the Kindergarten setting participated only in the pre and posttest of basic language skills, and were considered a control group for the study. A stratified random sampling of six children from one four-year-old group and two five year-old groups were administered the ten tasks of operational thinking, as well as pre and posttests of basic language ability.

Materials

The Boehm Test of Basic Language Concepts, Form A and Form B, 1971 Edition were used as pre and posttests of language ability. Reliability and validity data are reported for children at primary grade levels and for three socio-economic levels. Suggestions and directions for use of the tests with pre-school children, in this case, with four-year-olds,

were provided. All children were administered the pretest, Form A, during the second week of February,1985, and the posttest, Form B, during the second week of May,1985. The pre and posttest comparisons were made for all groups in order to have a second measure on language ability and to evaluate any degree of maturation over the three month period that may have occurred. The sub-categories of each form of the fifty question language concept test included 21 items related to space concepts, 15 related to quantity, 6 for time, and 8 questions related to the concepts of classification/seriation. Form A and Form B included items that involved parallel questions on each of the two forms. All testing was carried out by the two researchers for this study with some assistance in managing the test situation by the teachers in each of the classes.

The ten Piagetian tasks were selected from Piaget Systematized by Gilbert Voyat (1982), a text which presents 150 Piagetian tasks with suggested protocols for administration and evaluative criteria for the measurement of performance levels. The basis upon which specific tasks were selected was the relevance for children at ages four and five as reported by Voyat, and their inclusion of the concepts of space, quantity, and classification/seriation. The code numbers and titles for the specific tasks are: 120 E7 Classification and Relative Size of Classes; 62 N18 Additive Composition of Classes; 5 G5 Conservation of Length; 50 N6 One-to-One Correspondence; 56 N12 Serial Correspondence; 59 N15 Seriation; 45 N1 C Conservation of Substance; 48 N4 Conservation of Continuous Quantities; 16 G16 Conservation of Area; 8 G8 Locating a Point on a Plane. Tasks 1,2,5, and 6 were related to operational knowledge of classification/seriation; tasks 3,9, and 10 to operational knowledge of space concepts; and tasks 4, 7, and 8 were related to concepts of quantity. All tasks were administered over a two-day period to all children at both day care centers by the two chief investigators. In order to insure reliability in task administration,

both researchers were present during the testing on the Piagetian tasks. The scoring for the child's performance on each of the tasks followed the rating of 1 to 3 suggested by Voyat, that is, 1 for non-achievement, 2 for ambivalance, and 3 for achievement of the task with certainty.

Findings

When the three groups of five-year-olds, one from Kindergarten, and two from day care centers, were compared with four-year-old day care children on basic language concepts, significant differences were found. The one way analysis of variance comparing all groups resulted in an F ratio of 12.91, which was well beyond the 4.31 required for the .01 level of significance which has been accepted for all comparisons in this study. The four-year-olds scored significantly lower than all other groups. The data for this comparison is reported in Table 1.

Insert Table 1 here

Although there was some variance within groups, the largest variance was reported for differences between groups. In order to further analyze these differences, t tests were used to compare the means of the groups. The t test between the four-year-olds mean and each of the five-year-old groups means resulted in t scores of 3.976, 6.367, and 3.58, all significant beyond the required 2.797 for the .01 level. The only other comparison that resulted in t test significant results was the comparison between the Kindergarten children and one group of five-year-old day care children. The t test score for the comparison of these two means was 2.97, slightly beyond the required 2.797 for .01 level of significant differences. Therefore there was some indication of the influence of the day care experience in this instance on children's language ability. The major factor,however, appeared to be the age of the children in the comparisons of differences on knowledge of basic language skills concepts.

In order to evaluate differences due to sex, a two way analysis of variance was used for groups of boys and girls at ages four and five. Since, however, the number of girls who were in the Kindergarten without previous day care experience was minimal, the Kindergarten group was dropped from the comparison of sex differences for the age groups on basic language concepts. The subsequent comparison resulted in an F ratio of 1.849 for the interaction between age and sex, which did not attain significance. The main effect of group membership, that is, age, resulted in an F ratio of 16.454 which was significant beyond the .01 level. The results of this comparison are reported in Table 2. It would appear that age was the most predominant factor in the

Insert Table 2 about here

differences and that sex did not appear to be a major factor.

Since the critical interest of this study was the relationship between the young child's operational intelligence and language ability, a stratified random sampling of children were selected who scored high, medium, and low on the pretest of language ability. These children were administered the ten Piagetian tasks. Six children of five years of age from each of the two day care centers, and one group of four-year-olds from the day care center constituted the experimental group. The Kindergarten children were not included in the operational tasks since they served as a control group on basic language ability. The analyses included correlational comparisons between total scores on basic language concepts and scores on operational tasks followed by parallel comparisons on the sub-categories of space, quantity, and classification/seriation. The results of these comparisons are reported in Table 3.

Insert Table 3 about here

Only the children who scored low on language ability demonstrated a

significant relationship between their low performance on operational tasks and these correlations persisted in the sub-category of quantity. It can be observed from the data presented in Table 3 that the children performing at the highest level in basic language concepts demonstrated a trend toward negative correlations between their superior performance on language and their lack of attainment on the operational tasks. This was true for the comparison of total scores as well as for the sub-categories of quantity and classification/seriation. In two instances the correlations are extremely low indicating a lack of relationship.

After a period of three months, a posttest using Form B of the Boehm Test of Basic Language Concepts was administered to all groups, in order to have a second measure of language concepts and to evaluate differences that might be due to maturation. Since the pretest scores revealed significant differences between the four and five year olds, an analysis of covariance was used to compare scores on the posttests. The data for this comparison is reported in Table 4.

Insert Table 4 about here

The attained F ratio of 2.87 indicated non-significant differences when the effects of pretest differences were removed through the statistical comparison. The differences in knowledge of basic language concepts continued to be a result of age differences. It can be observed that all groups improved slightly, but the four-year-olds continued to lag behind their five-year old peers to a significant degree on knowledge of basic language concepts.

Conclusions and Discussion

In agreement with much of the literature and research findings reported, there are substantial differences in the four and five year olds knowledge of basic language concepts. As Chipman and Sinclair's research clearly shows,

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the child at five years has a high degree of language competence. This same level of language ability has been shown to be consistently lacking in four year olds when tested both at mid-year and at the end of the school year. Also, the factor of attending a day care center does not appear to impact on the child's ability in language since the five year olds from both the Kindergarten and the day care settings attained scores that were largely similar. Moreover, when comparisons were made for sex differences, none were found and age remained the predominant variable.

The second major hypothesis of the study was the consideration of the relationship between language and performance on tasks of operational knowledge. The randomly selected groups of children with three levels of language ability and the two age groups also confirmed some of the previously cited research findings. It has been observed in numerous studies and suggested by Piaget that the child attains knowledge of operational intelligence about age seven. As noted above, the child has almost adult competence in language ability by age five. This was borne out by the findings in that the correlations between language and Piagetian task performance for five year olds resulted in negative correlations. Thus as the child of five advanced in language, there was not a parallel grasp of operational knowledge. However, with the younger child of four, their lower performance on language did parallel their lower performance on the operational tasks and positive and significant correlations were found. The child of four has less knowledge of basic language concepts and is far less capable in the area of operational intelligence.

The lack of successful attainment on operational tasks could have been anticipated for children of four or five. The pre-operational level child is often unable to "stand back", that is, decenter, and relies on one perceptual variable to the exclusion of significant others. For example, the upper level of the water is considered without taking into account of the width of the glass.

Basic language concepts, on the other hand, were presented as static pictures which may have facilitated the child's choice of the three given samples. As suggested by Sinclair and Bloom, the child's familiarity with certain common concepts such as "some" or "many" may have been learned through some type of modeling and have functioned as pseudo-structures that facilitated correct responses. It would appear that while cognition underpines other symbolic functions, certain systems such as langauge may have been learned through parental modeling and reinforcement experiences. In addition, while the development of the perceptual system appears to provide data, it is used selectively by the child and interferes with the ability to decenter and thus use all the information available to allow for correct responses on the operational tasks.

Undoubtedly, further investigation needs to be done for a more definitive answer to the relationship between the language and cognitive systems. Since this study involved children at the pre-operational level of development, one recommendation for further investigation would be the inclusion of these same variable in a more longitudinal study. This would present a more complete picture of the variations and fluctuations in these interrelationships in the child's development of language and cognition.

Table 1

Comparisons of All Groups on Pretest of Boehm Basic Language Concepts

Group	Mean	N	SD
I Day Care (5 yr. olds)	36	13	5.83
II Day Care (5yr. olds)	40	13	3.87
III Day Care (4yr. olds)	26	13	3.75
IV Kindergaretn (5 yr. olds)	34	13	4.18

Analysis of Variance Table

Source of Variance	df	SS	MS	F ratio
Total	51	3088		
Between Groups	3	1379	459.6	12.91 *
Within Groups	48	1709	35.6	

* $p < .01$

Table 2

Comparison of Basic Language Pretests for Boys and Girls of All Day Care Groups

Sex	Group I (5 yr. olds) Means	Group II(5yr.olds) Means	Group III(4 yr.olds) Means
Boys	32.29	39.83	26.57
Girls	39.50	39.57	25.00

Two-Way Analysis of Variance Table

Source of Variance	SS	df	MS	F ratio
Main Effects				
Groups	1291.54	2	645.77	16.454 *
Sex	31.18	1	31.18	.794
Two-Way Interactions(Group/Sex)	145.166		72.58	1.849

* $p < .01$

Table 3

Correlations between Performance on Basic Language Concepts and Piagetian Tasks

Levels	Total Boehm X & Piagetian Task Score	Space	Quantity	Class./Seria.
High	r = -.262	r = .041	r = -.062	r = -.367
Medium	r = .337	r = .339	r = .240	r = .083
Low	r = .793 *	r = .053	r = .820*	r = -.128

Table 4

Comparison of All Groups on Boehm Posttest of Basic Language Concepts

Groups	Mean	N	SD
I Day Care(5 yr. olds)	38	13	1.41
II Day Care(5 yr. olds)	40.5	13	5.57
III Day Care(4 yr.olds)	30	13	5.92
IV Kindergarten (5 yr. olds)	39	13	6.0

Analysis of Covariance Table

Source of Variance	SS	df	MS	F ratio
Between Groups (Adjusted)	268	3	89.3	2.87 NS
Within Groups (Adjusted)	1463	47	31.12	
Total (Adjusted)	1731	50		

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Acknowledgement should be made to Rudy Hutchinson, Director of Model Cities Day Care Center and Phyllis Toner, Administrator of St. Joseph Day Care Center and the Early Childhood educators at both sites for their collaboration on carrying out many aspects of the project.